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***Simulium (Simulium) pingtungense*, a new species of black fly (Diptera: Simuliidae) from Taiwan**

Yao-Te HUANG and Hiroyuki TAKAOKA

*Department of Infectious Disease Control, Faculty of Medicine, Oita University,
Hasama, Yufu City, Oita, 879-5593 Japan*

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Abstract: *Simulium (Simulium) pingtungense* sp. nov. is described from reared adult, pupal and mature larval specimens collected from Pingtung and Taitung, Taiwan, and is placed in the *striatum* species-group within the subgenus *Simulium*. This new species has close similarities in the female, male and pupa to *S. (S.) quinquestriatum* (Shiraki) from Taiwan, from which it is distinguished by the absence of the paired dorsal protuberances on the larval abdomen. This new species is very similar in the pupa and larva to *S. (S.) wuzhishanense* Chen from China but differs in the female by the size of the sensory vesicle relative to the third maxillary palpal segment and in the male by the number of large upper eye-facets.

Key words: black fly, *Simulium*, Simuliidae, Taiwan

The *striatum* species-group of the subgenus *Simulium* of the genus *Simulium* consists of 18 species, most of which are distributed in the Oriental Region (Adler and Crosskey, 2008). This species-group is represented in Taiwan by only one species, *S. (S.) quinquestriatum* (Shiraki) (Shiraki, 1935; Takaoka, 1979, 2003), although one more species, *S. (S.) grisescens* Brunetti originally described from India (Brunetti, 1911), was erroneously included as a member of this species-group from Taiwan (Crosskey and Howard, 1997; Adler and Crosskey, 2008). Recently we collected the second species of the *striatum* species-group from Taiwan, which is characterized by lacking paired dorsal protuberances on the larval abdomen. This species is very similar in the female and male to *S. (S.) quinquestriatum*, which was originally described from female and male specimens (Shiraki, 1935) but is here treated to be distinct from the latter species on the basis of the difference in the color of the short hairs on the male scutum, which are coppery in this species

but yellow in *S. (S.) quinquestriatum* according to the original description (Shiraki, 1935). It should be noted that the color of the short hairs on the male scutum was described to be yellow or coppery in the revised description of *S. (S.) quinquestriatum* by Takaoka (1979). There is a possibility that the present species and *S. (S.) quinquestriatum* were mixed in adult male specimens examined by Takaoka (1979). In this paper we describe this species as new to science on the basis of reared adult, pupal and larval specimens.

The terms for morphological features used here follow those of Takaoka (2003). Holotype and paratype specimens of the new species are deposited at the Department of Infectious Disease Control, Faculty of Medicine, Oita University, Oita, Japan.

***Simulium (Simulium) pingtungense* sp. nov.**

DESCRIPTION. **Female.** Body length 2.4 mm. **Head.** Slightly narrower than width of thorax. Frons black, shiny when illuminated at

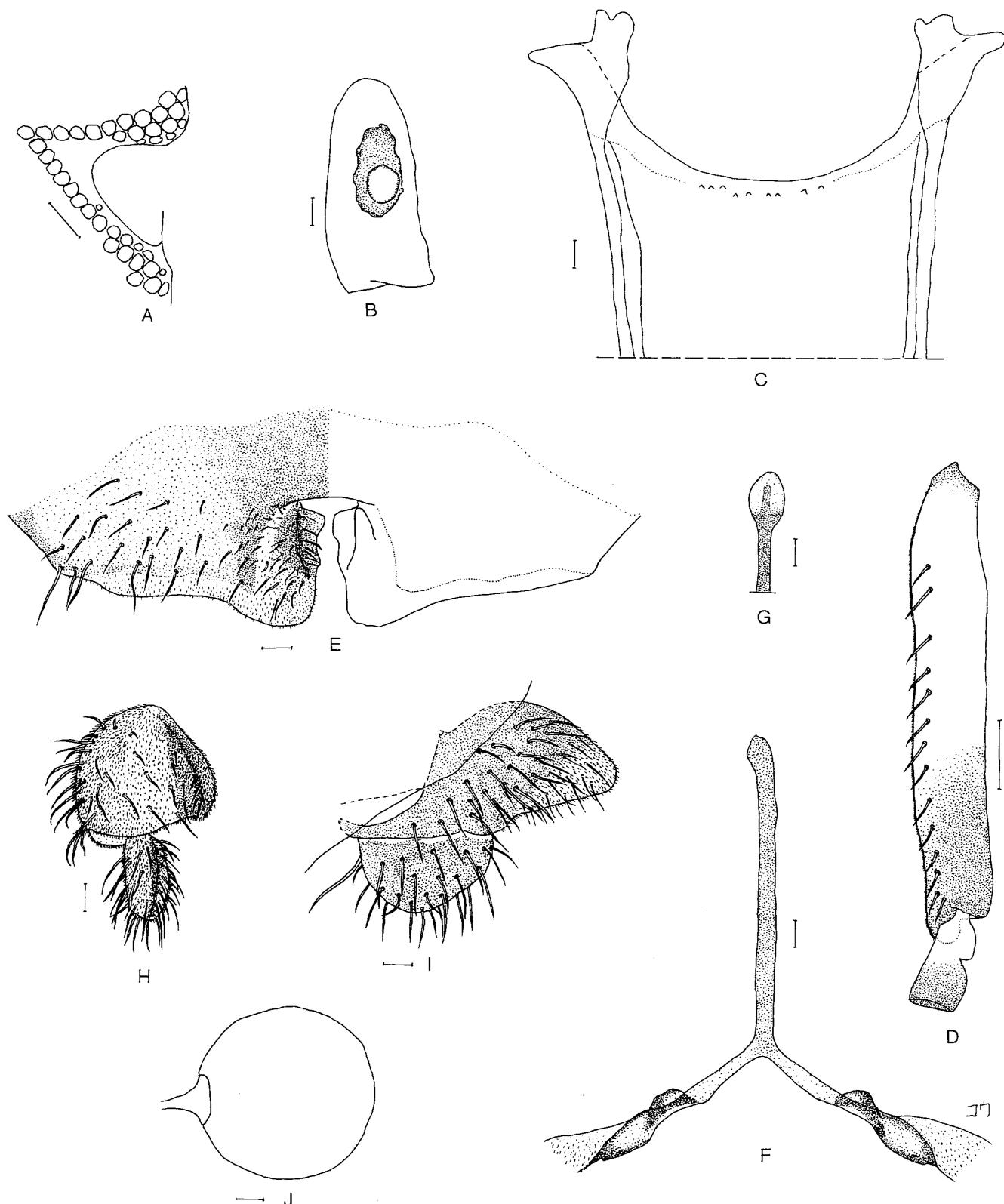


Fig. 1. Female of *Simulium (Simulium) pingtungense* sp. nov. A, fronto-ocular area (right side); B, 3rd segment of maxillary palp with sensory vesicle (right side and front view); C, cibarium; D, basitarsus and 2nd tarsal segment of hind leg showing calcipala and pedisulcus (left side and outer view); E, sternite 8 and ovipositor valves *in situ* (ventral view); F, genital fork (ventral view); G, inflated apex of stem of genital fork; H and I, paraprocts and cerci *in situ* (right side; H, ventral view; I, lateral view); J, spermatheca (lateral view). Scale bars. 0.1 mm for D; 0.05 mm for A; 0.02 mm for B and E-J; 0.01 mm for C.

certain angle of light, grayish-white pruinose in particular near antennal bases when illuminated at certain angle of light, with several dark simple long hairs along each lateral margin; frontal ratio 1.40–1.45 : 1.00 : 1.23–1.24; frons-head ratio 1.00 : 3.58–3.93. Fronto-ocular area (Fig. 1A) well developed, triangular, directed laterally. Clypeus brownish-black to black, slightly shiny and grayish-white pruinose when illuminated at certain angle of light, moderately covered with dark short to long hairs except medial portion of upper 1/3 to 1/2 bare. Labrum 0.64–0.69 times as long as clypeus. Antenna composed of scape, pedicel and 9 flagellomeres, brownish-black except scape, pedicel, and basal 1/3 to 1/2 of 1st flagellomere yellow when viewed dorsally (basal 1/2 to all of 1st flagellomere yellow when viewed ventrally). Maxillary palp composed of 5 segments, medium brown, proportional lengths of 3rd, 4th, and 5th segments 1.00 : 1.13–1.14 : 2.31–2.54; 3rd segment (Fig. 1B) somewhat swollen; sensory vesicle (Fig. 1B) elongate, 0.43–0.48 times as long as 3rd segment, with medium-sized opening submedially. Maxillary lacinia with 11–13 inner and 11–13 outer teeth. Mandible with 26–31 inner and 12–14 outer teeth. Cibarium (Fig. 1C) with 8 or 9 very minute tubercles. **Thorax.** Scutum brownish-black, shiny, densely covered with whitish-yellow recumbent short hairs, interspersed with dark brown short hairs on anterior surface and dark brown upright long hairs on prescutellar area; when illuminated in front and viewed dorsally, scutum thickly whitish-gray pruinose with 5 non-pruinose longitudinal vittae (1 medial, 2 submedial, and 2 lateral), all vittae united with transverse band on prescutellar region; scutum having reversed color, with 4 dark broad longitudinal vittae on whitish-gray ground when illuminated posteriorly; Scutellum dark brown, whitish-gray pruinose, with yellow recumbent short hairs and dark brown long hairs. Postnotum dark brown, shiny and whitish-gray pruinose when illuminated at certain angle of light, and bare. Pleural membrane bare. Katepisternum brownish-black, shiny, longer than deep, bare. **Legs.** Foreleg: coxa and trochanter yellowish-white; femur yellow basally, gradually darkened toward apex and with medium to dark brown apical cap; tibia dark brown to brownish black except extreme base pale yellow, with thin whitish-gray sheen

on outer surface when illuminated at certain angle of light; tarsus entirely brownish-black; basitarsus moderately dilated, 5.17 times as long as its greatest width. Midleg: coxa brownish-black; trochanter medium brown; femur medium to dark brown with apical cap dark brown to brownish-black; tibia medium brown to dark brown except base pale yellow, with thin whitish-gray sheen on posterior surface when illuminated at certain angle of light; tarsus medium brown except basal 5/6 of basitarsus and extreme base of 2nd segment yellowish-white. Hind leg: coxa dark brown to brownish-black; trochanter yellowish-white; femur and tibia dark brown except base yellowish-white and apical cap brownish-black; tibia with thin whitish-gray sheen on posterior surface when illuminated at certain angle of light; tarsus dark to brownish-black except basal 3/5 of basitarsus and basal 1/2 of 2nd tarsal segment yellowish-white; basitarsus (Fig. 1D) narrow, nearly parallel-sided, 6.61 times as long as wide, and 0.61 and 0.55 times as wide as greatest widths of tibia and femur, respectively; calcipala nearly as long as wide, and 0.42 times as wide as greatest width of basitarsus. Pedisulcus well marked. All tarsal claws simple. **Wing.** Length 2.4–2.5 mm; costa with spinules and hairs. Subcosta with dark hairs entirely. Hair tuft on stem vein brown. Basal portion of radius haired on apical 3/4 and bare on basal 1/4; R₁ with dark brown spinules and hairs; R₂ with hairs only. Basal cell absent. **Abdomen.** Basal scale light to medium brown with fringe of yellowish-white hairs. Dorsal surface of abdomen medium brown to brownish-black except basal 1/2 of segment 2 white, moderately covered with dark short to long hairs; tergite 2 bluish iridescent when illuminated at certain angle of light and tergites 6–9 shiny. Ventral surface of segment 7 with pair of large submedial sternal plates. **Genitalia.** Sternite 8 (Fig. 1E) well sclerotized, with deep quadrate medial depression posteriorly, with ca. 20 long hairs and ca. 15 short setae submedially near lateral border of depression on each side. Ovipositor valves (Fig. 1E) thin, membranous, covered with ca. 38 short setae and numerous microsetae, narrowly sclerotized along inner margin, rounded posteromedially, with ventrally produced lobe along little more than basal 1/2 of inner margin. Genital fork (Fig. 1F) of inverted-Y form; with slender stem (apex inflated in 1

female, Fig. 1 G), well sclerotized; arms of moderate width, each with strongly-sclerotized lateral ridge having distinct projection directed anterodorsally. Paraproct in ventral view (Fig. 1H) somewhat widened and in lateral view (Fig. 1I) much produced ventrally, 2.15 times as wide as long, well sclerotized basally, with numerous setae on apical transparent surface, with ca. 36 medium-long to long hairs on ventral and lateral surface. Cercus in lateral view (Fig. 1I) rounded posteriorly, 1.74 times as wide as long. Spermatheca (Fig. 1J) globular, unpatterned, well sclerotized except duct and small area near juncture with duct unsclerotized; internal setae present; both accessory ducts slender, slightly larger in diameter than major one.

Male. Body length 2.4–2.9 mm. **Head.** Wider than thorax. Upper eye consisting of 19 vertical columns and 20 horizontal rows of large facets. Face brownish-black, whitish pruinose. Clypeus brownish-black, whitish pruinose, moderately covered with dark brown simple long hairs except medial area bare longitudinally. Antenna composed of scape, pedicel and 9 flagellomeres, dark brown except scape, base of pedicel and base of 1st flagellomere somewhat lighter; 1st flagellomere elongate, 1.71 times as long as 2nd one. Maxillary palp with 5 segments, light brown, proportional lengths of 3rd, 4th, and 5th segments 1.00 : 1.32 : 3.05; 3rd segment (Fig. 2A) widened apically; sensory vesicle (Fig. 2A) ellipsoidal, 0.22–0.24 times as long as 3rd segment, and with medium-sized opening. **Thorax.** Scutum black, with white pruinose pattern (remarkably iridescent in light) composed of anterior pair of large spots curved posteromedially, with round tip on shoulders, large transverse spot on prescutellar area which is contiguous to anterior spots by broad band along lateral margins; anterior pair of spots moderately separated in middle from each other, changeable in shape and size depending on angles of light: pair of narrow subquadrate isolated spots near anterior margin when illuminated anterolaterally and viewed anterodorsally, or pair of narrow subquadrate spots along anterior margin connected to lateral band when illuminated anterolaterally and viewed dorsally; scutum densely covered with copper-colored short hairs interspersed with several dark brown upright long hairs on prescutellar area. Scutellum dark brown, with dark brown long

upright hairs as well as dark brown short hairs. Postnotum dark brown, whitish pruinose and slightly shiny when illuminated at certain angle of light, and bare. Pleural membrane bare. Katepisternum longer than deep, dark brown, white pruinose and bare. **Legs.** Foreleg: coxa yellowish-white; trochanter dark yellow to light brown except lower surface yellowish; femur dark yellow to medium brown with apical cap dark brown; tibia dark brown except extreme base dark yellow; tarsus brownish-black, with thick dorsal crest of short hairs; basitarsus moderately dilated, 6.43 times as long as its greatest width. Midleg: coxa dark brown; trochanter medium to dark brown with base yellow; femur medium to dark brown; tibia medium to dark brown with base very narrowly yellow; tarsus medium brown except basal 3/5 of basitarsus and extreme base of 2nd segment yellowish-white. Hind leg: coxa dark brown; trochanter yellowish-white; femur medium to dark brown with base yellowish-white and apical cap brownish black; tibia dark brown to brownish-black with base yellowish-white; tarsus medium to dark brown except little more than basal 1/2 of basitarsus and basal 1/2 of 2nd segment yellowish-white; basitarsus (Fig. 2B) greatly enlarged, gradually widened from base to apical 1/3, then nearly parallel-sided or slightly narrowed, 4.48 times as long as its greatest width, 0.72 and 0.78 times as wide as greatest widths of hind tibia and femur, respectively; calcipala slightly shorter than its basal width, and 0.31 times as wide as greatest width of basitarsus; pedisulcus well marked. **Wing.** Length 2.4–2.5 mm; hair covering nearly as in female except subcosta and basal portion of radial vein bare. **Abdomen.** Basal scale brownish-black, with fringe of yellow hairs. Dorsal surface of abdomen brownish-black to black except anterior 1/2 of 2nd segment light to medium brown, covered with dark short to long hairs; segments 2 and 5–7 each with pair of white pruinose (bluish iridescent in light) dorsolateral spots broadly connected in middle to each other on segment 2 but narrowly so or not on other segments. **Genitalia.** Coxite in ventral view (Fig. 2C) nearly quadrate, 1.13 times as long as its greatest width. Style in ventral view (Fig. 2C) elongate, longer than coxite, with apical 1/2 gently curved inward, with short basal protuberance directed mediadorsally, and with stout spine subapically;

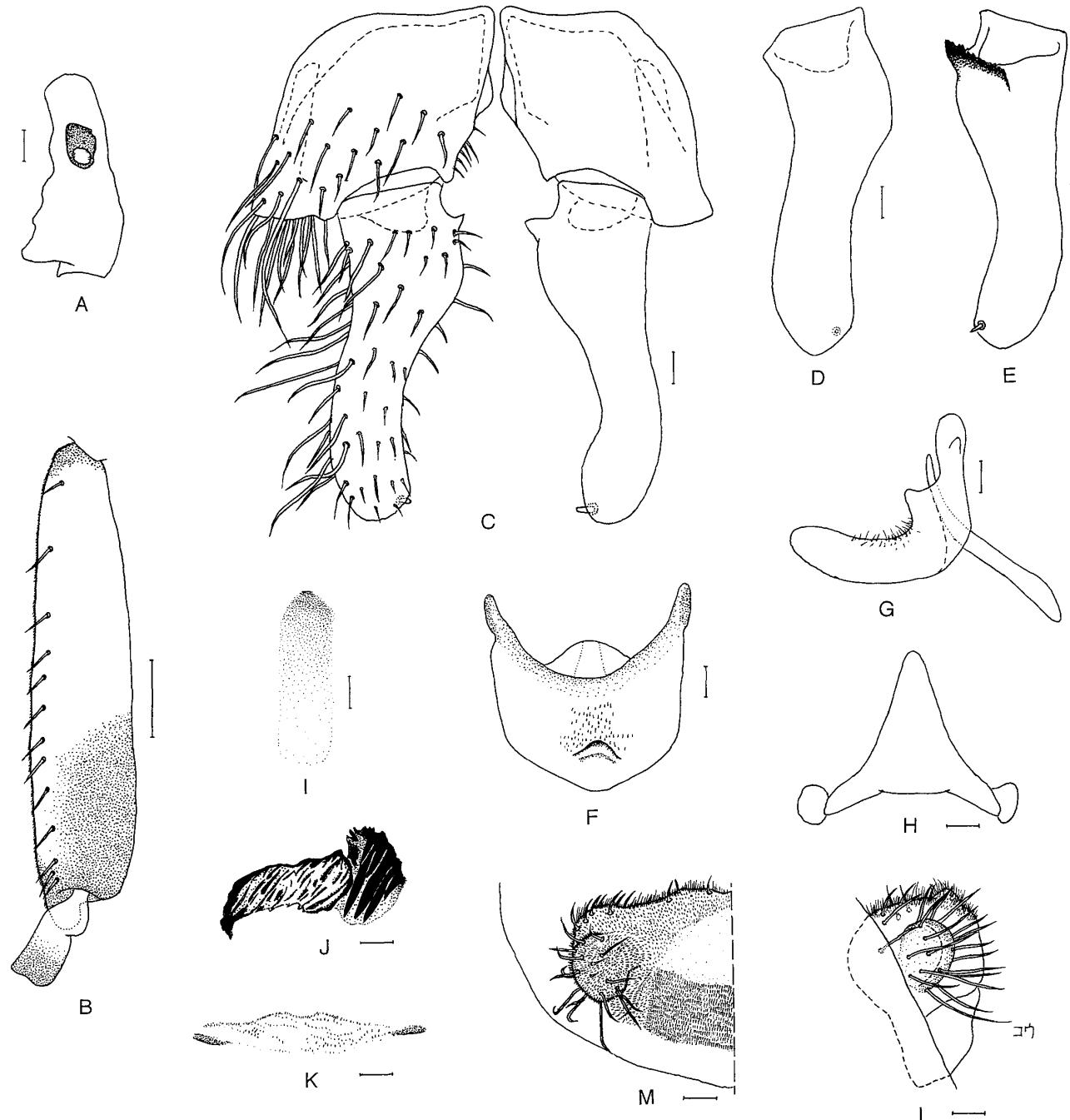


Fig. 2. Male of *Simulium (Simulium) pingtungense* sp. nov. A, 3rd segment of maxillary palp with sensory vesicle (left side and front view); B, basitarsus and 2nd tarsal segment of hind leg showing calcipala and pedisulcus (left side and outer view); C, coxites, styles *in situ* (ventral view); D and E, style (D, ventrolateral view; E, medial view); F and G, ventral plate and median sclerite *in situ* (F, ventral view; G, lateral view); H, ventral plate (end view); I, median sclerite (anterodorsal view); J, paramere (right side and end view); K, aedeagal membrane and dorsal plate (end view); L and M, 10th abdominal segments and cerci *in situ* (L, right side and lateral view; M, right side and end view). Scale bars. 0.1 mm for B; 0.02 mm for A and C-M.

style in ventrolateral view (Fig. 2D) nearly parallel-sided from base to basal 1/3, then narrowed to middle and again parallel-sided toward near apex; style in medial view (Fig. 2E) with dark well-sclerotized basal protuberance

having saw-like rugged apical margin. Ventral plate in ventral view (Fig. 2F): body broad, with anterior margin concave and posterior margin rounded, almost bare except medial portion covered with minute setae; basal arms

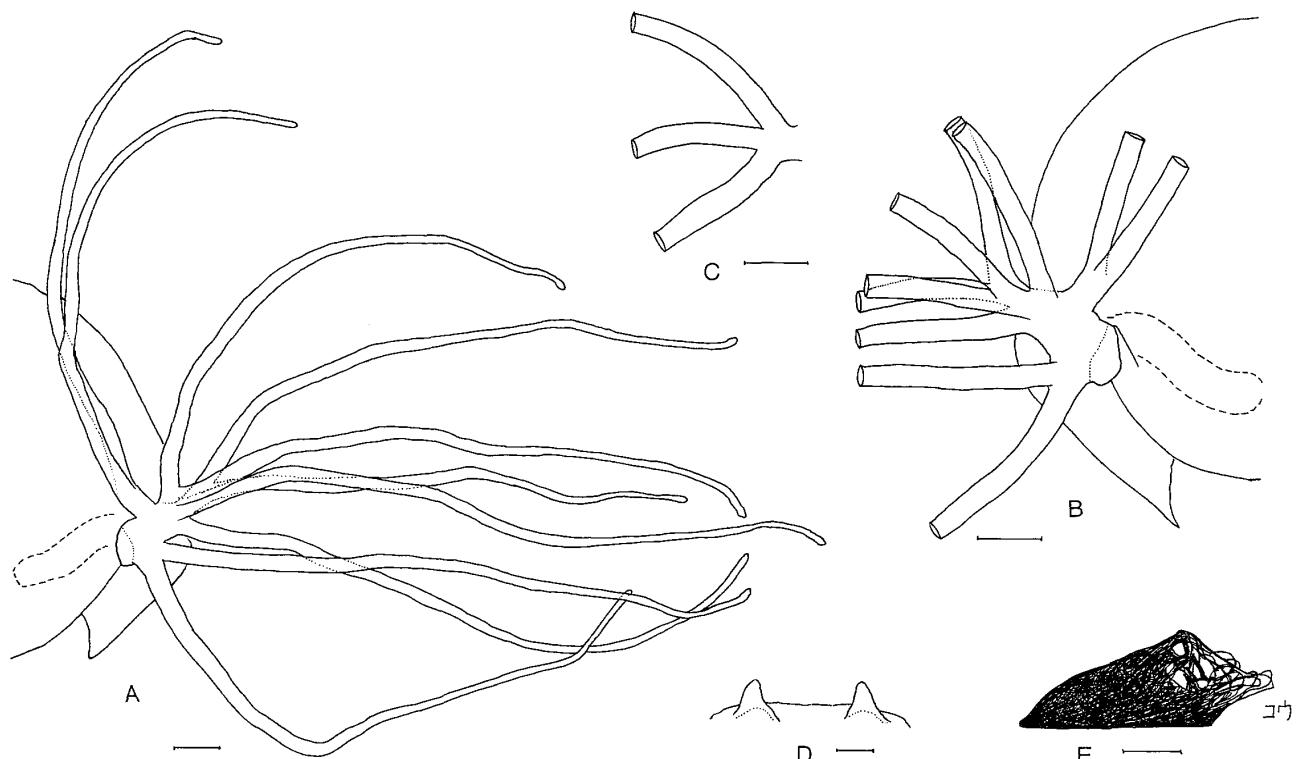


Fig. 3. Pupa of *Simulium (Simulium) pingtungense* sp. nov. A, gill filaments (right side and outer view); B, basal portion of gill filaments showing different arrangement of middle triplets; C, basal portion of middle triplets of gill showing 3 individual filaments; D, terminal hooks (end view); E, cocoon (lateral view). Scale bars. 1.0 mm for E; 0.1 mm for A-C; 0.02 mm for D.

short, stout and directed forward; ventral plate with prominent median process sharply narrowed to more or less small rounded distal tip; ventral plate in lateral view (Fig. 2G): body abruptly bent ventrally nearly at right angle; ventral plate in end view (Fig. 2H): body and ventrally-produced median process nearly equilateral triangular, and bare. Median sclerite in ventral and lateral views (Fig. 2F, G) moderately sclerotized, with base located apart in front of anterior margin of ventral plate; median sclerite in anterodorsal view (Fig. 2I) plate-like, wide, nearly parallel-sided. Paramere in end view (Fig. 2J) of moderate size, with 3 distinct long and 3 or 4 short hooks apically. Aedeagal membrane in end view (Fig. 2K) moderately covered with minute setae; dorsal plate in end view (Fig. 2L) sclerotized only on both lateral ends. Ventral surface of 10th abdominal segment (Fig. 2M) with 11 distinct hairs on each posterolateral corner. Cercus (Fig. 2L, M) rounded, with 17 distinct hairs.

Pupa. Body length 2.5–2.9 mm. **Head.** Integument yellowish-brown, moderately covered with relatively large round tubercles on frons

and relatively small tubercles on other areas except parts of antennal sheath sparsely to moderately covered with small tubercles; antennal sheath without any protuberances; face with pair of simple (rarely bifid) long trichomes, and frons with 2 (rarely 3) pairs of simple, bifid or trifid, medium-long to long trichomes. **Thorax.** Integument dark yellow to yellowish-brown, moderately covered with relatively large round tubercles on dorsal surface of anterior 2/3, and relatively small tubercles on other areas; thorax on each side with 3 branched (split into 4 or 5 branches) very long trichomes dorsomedially, 2 stout, branched trichomes (1 medium-long and quadrifid, 1 bifid and very long) anterolaterally, 1 simple, bifid or trifid, long somewhat stout trichome posterolaterally, and 3 trichomes (1 bifid or trifid, medium-long and slender, 2 simple, very long and stout) ventrolaterally. Gill (Fig. 3A) composed of 10 slender thread-like filaments, widely spread like fan, shorter than pupal body, arranged in groups of 2+(3+3)+2 filaments from dorsal to ventral, with somewhat swollen transparent organ ventrally (partially broken) at base; middle triplets arranged as 2+

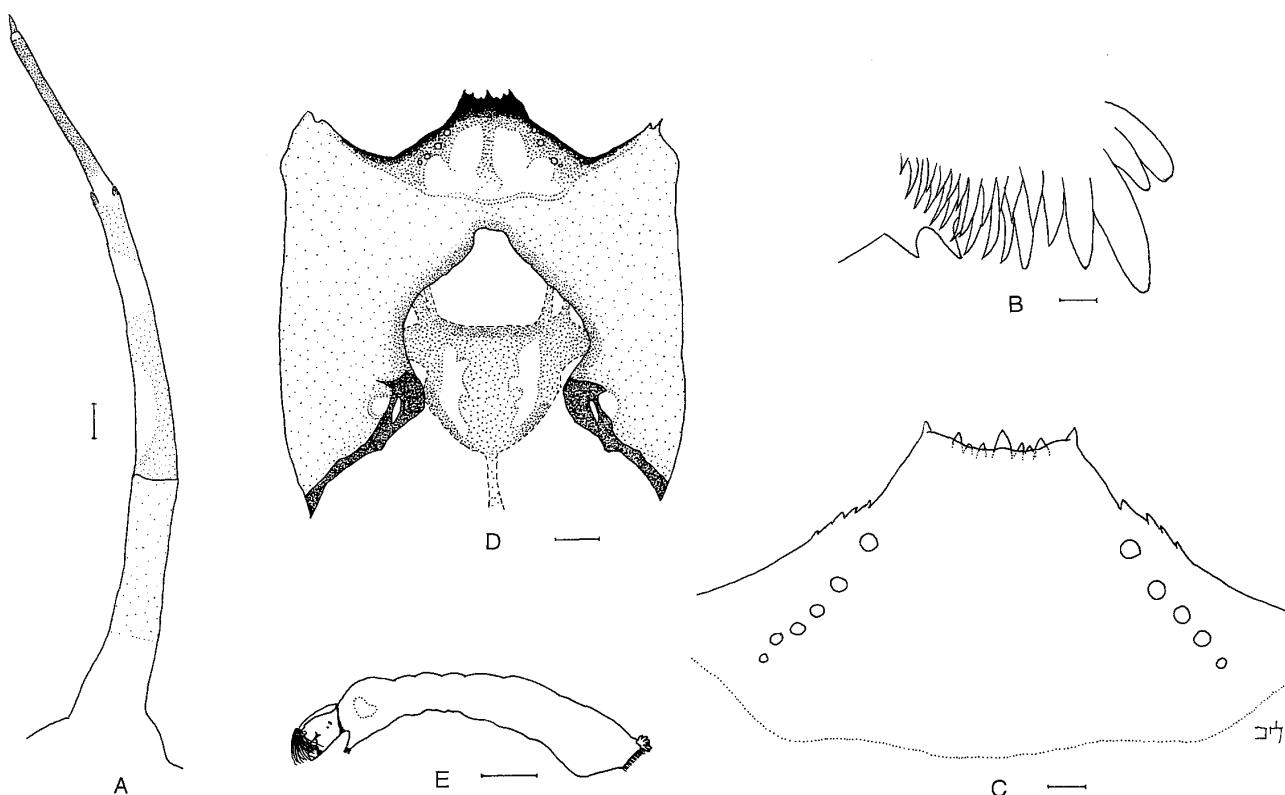


Fig. 4. Mature larva of *Simulium (Simulium) pingtungense* sp. nov. A, antenna (left side and lateral view); B, tip of mandible; C, hypostoma; D, head capsule showing postgenal cleft (ventral view); E, whole body (side view). Scale bars. 1.0 mm for E; 0.1 mm for D; 0.01 mm for B and C; 0.02 mm for A.

1 (Fig. 3A) or 1+2 (Fig. 3B) or 1+1+1 (Fig. 3C); all filaments light brown, gradually tapered toward apex; 2 filaments of dorsal pair subequal in length (1.0–1.2 mm long) and thickness to each other and shorter than other filaments which are subequal in length (1.4–1.6 mm long) and thickness to one another; cuticle of all filaments with well-marked annular ridges and furrows though becoming less marked apically, densely covered with minute tubercles. **Abdomen.** Dorsally, segment 1 light brown, sparsely covered with small tubercles, and with 1 (2 in left side of 1 pupa) simple slender short seta on each side; segments 2–8 unpigmented and without tubercles; segment 2 with 1 simple slender short seta and 5 simple (rarely bifid) spinous very short setae (of which 4 are stout) submedially on each side; segments 3 and 4 each with 4 hooked spines and 1 very short somewhat spinous seta on each side; segment 5 without spine-combs and comb-like groups of minute spines; segments 6 and 7 with comb-like groups of minute spines but without spine-combs; segments 8 with spine-combs in transverse row and comb-like groups of minute spines on each side; segment 9 yellow, with

pair of distinct cone-shaped terminal hooks (Fig. 3D), with comb-like groups of minute spines on each side, and with or without spine-combs, which are, if present, somewhat smaller than those on segment 8. Ventrally, segment 4 with few simple slender very short setae on each side; segment 5 with pair of bifid hooks submedially and few very short simple slender setae on each side; segments 6 and 7 each with pair of bifid inner and simple outer hooks somewhat spaced from each other and 1 very short simple slender seta on each side; segments 4–8 with comb-like groups of minute spines. Each side of segment 9 without grapnel-shaped hooklets. **Cocoon** (Fig. 3E). Shoe-shaped, loosely and elaborately woven by thick strands anteriorly, with numerous small interspaces in webs anterolaterally, anteroventrally and on upper 1/2 of front wall; 1/2 of ventral surface with floor posteriorly; 4.0–4.8 mm long by 1.6–1.7 mm wide.

Mature larva. Body length 6.5–7.7 mm. Body color light brown or grayish-brown or dark green except dorsal surface of thoracic segment 3 and intersegmental areas between abdominal segments 1 and 5 usually widely

unpigmented, thus appearing to have dark broad transverse band each on abdominal segments 1 to 4. Cephalic apotome usually whitish-yellow to dark yellow except narrow area along posterior margin dark brown to brownish-black; head spots faintly to moderately positive though posterolateral spots often indistinct; lateral surface of head capsule whitish-yellow with faint eyebrow or dark yellow to light brown with eye-spot region whitish and 2 large spots in front of posterior margin negative; ventral surface of head capsule yellow to light brown. Antenna (Fig. 4A) composed of 3 segments and apical sensillum, slightly longer than stem of labral fan; length ratio of segments (from base to tip) 1.0 : 1.28–1.46 : 0.76–0.79. Labral fan with 47–52 main rays. Mandible (Fig. 4B) with mandibular serrations composed of 2 medium-size teeth, without supernumerary serrations; comb-teeth decreasing in length from 1st to 3rd. Hypostoma (Fig. 4C) with 9 anterior teeth, of which median and each corner tooth longer than others; lateral margins weakly serrate apically; 5 or 6 hypostomal bristles diverging posteriorly from lateral border on each side. Postgenal cleft (Fig. 4D) very deep, rounded, 6.1–7.7 times as long as postgenal bridge; subesophageal ganglion moderately pigmented. Pharate pupal gill with 10 filaments. Thoracic and abdominal cuticle bare except last segment of abdomen moderately covered with short colorless setae on each side of anal sclerite, and without dorsal pairs of conical protuberances (Fig. 4E). Rectal scales present. Rectal papilla of 3 lobes, each with 5–7 finger-like secondary lobules. Anal sclerite X-shaped, with broadened anterior arms 0.66–0.70 times as long as posterior ones. Last abdominal segment bulged laterally but lacking ventral papillae. Posterior circlet with 98–106 rows of hooklets with up to 18–20 hooklets per row.

TYPE SPECIMENS. Holotype male (with associated pupal exuviae and cocoon) reared from pupa (preserved in 80% ethanol), collected from a slow-flowing small stream (width 3.0–4.0 m, exposed to sun, altitude about 50 m), Jioupeng, Manzhou, Pingtung County, Taiwan, 3. II. 2008, by Yao-Te Huang. Paratypes: 2 females, 3 males (all with associated pupal exuviae and cocoons), 6

pupae and 5 mature larvae, same data as those of the holotype; 4 females, 1 male (all with associated pupal exuviae and cocoons) and 5 mature larvae, collected from a rapid-flowing river (Gangkou River, width 15.0–20.0 m, exposed to sun, altitude about 50 m), Lide, Manzhou, Pingtung County, Taiwan, 3. II. 2008, by Yao-Te Huang; 2 males (with associated pupal exuviae and cocoons) and 4 mature larvae, collected from a slow-flowing small stream (width 0.5–0.7 m, exposed to sun, altitude 241 m), Guanshan Township, Taitung County, Taiwan, 1. II. 2008, by Yao-Te Huang.

ECOLOGICAL NOTES. The pupae and larvae of this new species were collected from trailing grasses and fallen tree leaves in the water, together with *S. (Gomphostilbia) tuenense* Takaoka, *S. (Nevermannia) aureohirtum* Brunetti, *S. (N.) chitoense* Takaoka, *S. (Simulium) shirakii* Takahashi and Kono.

ETYMOLOGY. The species name *pingtungense* refers to the name of the locality, Pingtung, where this new species was collected.

REMARKS. *Simulium* (*S.*) *pingtungense* sp. nov. is readily assigned to the *striatum* species-group within the subgenus *Simulium* by the characteristic shape of the female and male genitalia (Fig. 1E and Fig. 2F) and appears to be distinctive among this species-group in lacking paired dorsal protuberances on the larval abdomen. This new species is very similar to *S. (S.) wuzhishanense* Chen described from Hainan, China (Chen, 2003) in that both species have the haired basal portion of the radial vein of the female, the pupal gill with 10 filaments arranged in groups of 2+3+3+2 filaments from dorsal to ventral, and the larval abdomen without paired protuberances on the dorsal surface. However, *S. (S.) pingtungense* sp. nov. is distinguished from the latter species in the female by the length ratio of the senso-

ry vesicle against the third maxillary palpal segment (0.43–0.48 in this new species vs. 0.30–0.33 in *S. (S.) wuzhishanense*), and in the male by the number of large eye-facets (19 vertical columns and 20 horizontal rows in this new species vs. 12 vertical columns and 14 horizontal rows in *S. (S.) wuzhishanense*), the color of short hairs on the scutum (coppery in this new species vs. yellow in *S. (S.) wuzhishanense*) and paired shiny spots on the abdomen (on the segments 2 and 5–7 in this new species vs. on the segments 2, 6 and 7 in *S. (S.) wuzhishanense*).

This new species appears to be related to *S. (S.) quinquestriatum*, *S. (S.) grisescens* from India and *S. (S.) subpalmatum* Davies and Györkös from Sri Lanka in having the haired basal section of the radial vein of the female as well as the pupal gill with 10 slender filaments arranged in groups of 2 + 3 + 3 + 2 filaments from dorsal to ventral (Shiraki, 1935; Takaoka, 1979; Brunetti, 1911; Puri, 1932; Davies and Györkös, 1992). It is however distinguished from *S. (S.) quinquestriatum* by the paired protuberances and dark spinous setae on the dorsal surface of the larval abdomen which are absent in this new species but present in *S. (S.) quinquestriatum*, from *S. (S.) grisescens* and *S. (S.) subpalmatum* by the male hind basitarsus which is yellowish-white on the basal 3/5 (Fig. 2B) in this new species and on the basal 1/2 in the two known species, and also from *S. (S.) subpalmatum* by the cocoon which has many open interspaces anteriorly (Fig. 3D) in this new species but no open interspaces in *S. (S.) subpalmatum*. There is no information as to the presence or absence of the paired dorsal protuberances on the larval abdomen of *S. (S.) grisescens* and *S. (S.) subpalmatum*.

This new species is distinguished from other species of the *striatum* species-group by the haired basal section of the radial vein of the female combined with the pupal gill with 10 slender filaments arranged in groups of 2 + 3 + 3 + 2 filaments from dorsal to ventral (Fig. 3A, B).

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